Re-investment, Survival and the Embeddedness of Foreign-Owned Plants

Colin Wren and Jonathan Jones

Department of Economics
University of Newcastle upon Tyne
Newcastle upon Tyne, UK, NE1 7RU.

Abstract

The paper examines if re-investment by foreign-owned plants embeds these plants leading to higher survival time durations. It utilizes project-based inward investment data for the North-East of England over the period 1985-98. The paper finds that plant re-investment increases the median survival duration of a start-up plant by about 50 per cent (from about 9 to 14 years), but only by about 20 per cent for large plants, where most job losses occur. However, from the time of re-investment the survival pattern does not differ significantly from that of a new plant starting-up at the same time with similar characteristics. Overall, the paper does not provide strong support for re-investment as a source of embeddedness.

Key words: Foreign direct investment, re-investment, survival, embeddedness.

Word count for text: 7,437 + notes, tables and references.

Address for correspondence: Dr Colin Wren, address as above, email c.m.wren@ncl.ac.uk.

Acknowledgements

For help with this study thanks go to the Regional Development Agency *One NorthEast*, and to the Investor Development Manager, Lesley Boughton. We are also grateful to the following: Graham Adams of Northumberland County Council; Gordon Ramsey of the Tyne and Wear Development Company; John Elliott and Joanne Newton of the County Durham Development Company and David Wood of the Tees Valley Development Company. For assistance with the data we would also like to thank Joan Davison of the Tyne and Wear Research and Information Unit at Newcastle, many local authority officers and to Mark Lea of the Department of Trade and Industry. Thanks also go to participants at presentations to the ESRC Urban and Regional Economics Seminar Group, Preston, June 2002 and to the International Regional Science Association meeting at Brighton, August 2002. The authors also gratefully acknowledge the assistance of Peter Dolton and John Wildman on minor technical details, but remain responsible for the paper's content.

Re-investment, Survival and the Embeddedness of Foreign-Owned Plants

Colin Wren and Jonathan Jones

1: Introduction

"3,000 Jobs to go in Motorola Closure", "Black and Decker cuts 1,000 jobs", "Vauxhall axes 2,000", "North-east jobs go as Viasystems fails", "NEC to close Scottish plant", "1,900 jobs to go as Ford confirms closure". These headlines are all taken from a national newspaper over recent years, and they indicate an important phenomenon.[1] This is the much-observed closure of large-scale foreign-owned plants, often in manufacturing. The closure of these plants and the associated job losses can have devastating impacts on local communities (Tomaney *et al*, 1999), but more so because they tend to be located in the areas of high unemployment, attracted to these areas by the subsidies available under UK regional policy (see Wren, 2002). It poses a dilemma for the policymaker who is keen to attract the foreign-owned plants, as it offers up the prospect of further substantial localized job losses in the wake of the failure of these plants.

There are a number of explanations for the failure of foreign-owned plants, especially the larger plants. These stem mainly from the fact that they tend to form a part of a multi-plant enterprise, giving rise to the so-called 'branch-plant phenomenon' (Fothergill and Guy, 1990). One explanation is that the branch plants are more vulnerable to economic conditions as their operation can be readily transferred to other plants in order to avoid fixed costs (Baden-Fuller, 1989).[2] Another reason is that the distance from the parent plant makes these plants vulnerable to closure, as it is the more remote plants that tend to be closed first (Watts and Kirkham, 1999). Finally, it is argued there is something in the nature of these plants that makes them more liable to closure, as they tend to be undertaking routine and relatively low value-added activities that can be carried on more cheaply elsewhere (see O'Farrell and Crouchley, 1987).

Studies of firm survival draw a distinction between single and multi-plant enterprises (eg. Reynolds, 1988; Dunne *et al*, 1989), and there is strong evidence that the branch plants are much more likely to close compared with exits by independently-owned single-plant enterprises (eg. Ghemawat and Nalebuff, 1990). However, even allowing for the structure of an enterprise, it appears that foreign-owned plants are more prone to failure than domestically-owned plants, and that this becomes more likely the larger in size is the plant. This has been found by Harris and Hassaszadeh (2002) for UK manufacturing and by Colombo and Delamstro (2000) in their study of Italian metalworking plants. The failure rates are strongest for the foreign-owned plants that commence by acquisition of an existing plant, rather than wholly new start-ups on a 'greenfield' site (see Delacroix, 1993 and McCloughan and Stone, 1998).

The response of the economic development agencies to the higher failure rates of foreign-owned plants is to 'embed' these plants in the local economy in order to forestall closure. The idea of embeddedness goes back to Granovetter (1985), and it is a focus for research on network formation (eg. Bala and Goyal, 2000). In this context, 'embeddedness' is defined in terms of the depth and quality of the relationships between inward investors and local firms and organisations, and the extent to which the plants provide other opportunities for local economic development (Phelps and MacKinnon, 2000). While this has become a focus for policy, the problem is that there is little hard evidence on the effect of these in reducing the closure rates of foreign-owned plants, no doubt because of the difficulties in quantifying the relationships and other features that go to make up embeddedness. However, as a potentially useful way of assessing this idea, Phelps *et al* (2003) identify five indicators of the embeddedness of a foreign-owned plant. These are corporate status and function; research, development and design activity; local supply chains; skills and training demands; and repeat investment.

The purpose of this paper is to examine the last of these indicators, ie. repeat investment by foreign-owned plants, and in particular to examine whether re-investment embeds these plants leading to higher survival durations. Re-investment is important, as it signals the commitment of a company to sustain its operation, and in the case of multi-plant enterprises it demonstrates the ability of a branch plant to compete for and win investment from the parent company (Young *et al*, 1994). However, the issue that the paper addresses is not whether re-investing plants are more likely to survive than firms that do not re-invest, as this seems trivially obvious. Rather, the issue is whether the survival of a plant from the time of the re-investment is greater than that for other foreign-owned plants that do not re-invest. If so, it suggests that a re-investment is qualitatively different from an initial investment, and it provides support for the idea of embeddedness in the form of repeat investment. It also has important policy implications in terms of encouraging re-investment by foreign-owned plants, as it gives the economic development agencies a concrete lever by which to root these investments in the local economy.

The analysis is undertaken for the North-East of England over the period 1985-98. This region has been a major recipient of foreign direct inward investment over this period. The study utilizes a unique dataset on investment projects that has been constructed by the authors for this region, based on data supplied by the main inward investment agencies. Unlike other data that have recently been used to investigate inward investment, the data are project-based, which offers a major advantage in allowing the identification of discrete re-investment projects that involve a enhancement of the plant's operating capacity, including the expansion of plant scale. While re-investing plants survive for longer periods of time, the paper finds that it is only a matter of a few years, and it is no different to the survival time duration of a new plant starting at the same time. Overall, the paper does not provide support for re-investment as a source of embeddedness.

In the next section the nature of the data are considered, and in section 3 the variables are set out. Section 4 analyses plant re-investment, examining both the probability of re-investment and the time duration to re-investment. Section 5 looks at plant survival and section 6 considers the issue of plant re-investment and embeddedness. Conclusions are drawn in section 7.

2: The Data

The data on which the study is based are described much more fully in Jones and Wren (2002a), so that only a broad outline is given here. The original source for much of these data is the Regional Development Agency (RDA) for the North East of England, *One NorthEast*. Since 1985, the RDA and its predecessors have collected information on all known investments by foreign-owned plants in the North-East region. These data are for individual projects, and form the basis for the quarterly returns that are collated for all regions by *Invest UK* (the former *Invest in Britain Bureau*), and which are reported for the UK as a whole.[2] The data are for prospective investments, and give information on the nature of each project, ie. if it is a start-up, acquisition, a joint venture or a re-investment project, for which the standard definitions apply.[3] It covers the period 1985-98, and it is believed to give a more or less comprehensive account of project-based foreign-owned investment in the region over this period.

In utilising these data there are several important issues. The first is the definition of a project (see Maylor, 2003). This is any discrete identifiable investment that the inward investor plans to carry out and have in place over the short run. It is generally within two years of the formal commitment to a project, possibly unannounced, although the period over which a project is realized can vary with the project type. In particular, an acquisition may have a much shorter implementation period than a start-up, as it involves existing assets, while in principle a joint venture could involve an acquisition, although these projects are relatively small in number. If an investment is staged over many years then it is treated as more than one project.

The second issue is that the data refer to 'significant investments' only, and it is these that are reported by *Invest UK* in its Annual Reports. No exact meaning is given to this term by the inward investment agencies, but while it is not problematic in the case of the start-up, acquisition and joint venture projects, as all of these can be classified as ‘significant’, it has implications for what is included as a re-investment project. In general, a re-investment involves some significant enhancement of a plant’s operating capacity, including an expansion of the plant scale. Indeed, the inward investment agencies refer to these re-investments as “expansions”, which suggests that they always involve an increase in the productive capacity or scale of a plant, eg. the installation of a new production line. Importantly, for this study, it means that they exclude the routine and generally small-scale activities that do not add to plant scale, such as the simple replacement of existing machinery. This means that they are exactly the kinds of re-investment project that we would want to include in our study as a source of plant embeddedness.

Finally, there is the issue of the comprehensiveness of the dataset, and the possibility of missing data on projects. However, a separate plant-level study by Jones and Wren (2002b) on the realization of the prospective project scales, in terms of the number of prospective jobs that are achieved as plant employment, makes us believe that the data on the re-investment projects are substantially complete.[4] For the start-ups, acquisitions and joint ventures, there is still the possibility of missing projects, which would affect the representativeness of the plant-level data, but again we do not believe that this is problematic. Thus, overall, the data are believed to be a comprehensive, and therefore representative of ‘significant’ project-based investments carried out by foreign-owned plants in the North-East region over the period 1985-98.

The data were supplied on a project basis, and considerable efforts were made to check, refine and improve on the data supplied by the RDA, for which further details are given in Jones and Wren (2002a).[5] This included rearranging the project-based data onto a plant basis, which needed some notion of a plant. A plant is defined as an individual establishment at which broadly the same activity is carried out more or less continuously over time and in the North-East region. It means that an establishment is regarded as the same plant even though it may have changed its name, its ownership or location within the region.[6] It reflects the interest in the economic use to which the assets provided by the inward investor are being put within the region, and it provides a consistent method of assigning a relatively large number of projects to plants. A plant that opens as a start-up, acquisition or joint venture over 1985-98, but that at some point no longer satisfies this definition up to the year 2000, is treated as a closure, on which more is said below.

Having completed the above tasks, the data give details of 550 projects carried out by 337 foreign-owned plants in the region over the period 1985-98. Of these, 265 plants commenced in foreign ownership during this period, and it is these that form the basis for the study.[7] These comprise 164 start-up plants, 79 plants that commenced by acquisition of an existing UK-owned plant and 22 joint ventures. Table 1 shows the number of Subsequent projects undertaken by each plant after its Initial investment, ie. after the first investment in the study period. It also indicates the nature of each Subsequent investment, whether it is a re-investment, an acquisition or a joint venture. In total, the 265 plants undertook 416 projects over 1985-98, of which 151 are Subsequent investments. The vast majority of these are re-investments. The Table also shows the number of Multiple Investors associated with each plant type (see below), and it shows that 50 of the plants closed by 2000 (18.9 per cent), of which most are start-up plants.

3: The Variables

The plant-level variables that form a part of the analysis are given in Table 2, along with some simple descriptive statistics on the 416 projects implemented by these 265 plants. The data on the plants generally refer to the end of the study period, while the information on the projects refers to the project commitment date. Further details of the data are given in Jones and Wren (2002a). Most of the variables are categorical in nature, and to simplify matters they are grouped into a relatively small number of categories, reflecting the areas of interest outlined below.[8] The table shows that there is good data coverage across the plants and projects.

The plant variables are the county location (*COUNTY*: Northumberland, Tyne and Wear, County Durham and Cleveland); the country of origin (*ORIGIN*: Western Europe, the USA, Far East and the Rest of the World); the industrial sector (*SECTOR*: manufacturing and all other sectors); the manufacturing activity (*MANUF*: transport equipment, communications, chemicals, machinery and equipment, and the rest of manufacturing); the plant age (*AGE*); and whether the plant implemented a Subsequent investment or not over 1985-98 (*MULTIPLE*).

The first of these captures differences between the metropolitan areas (Tyne and Wear, and Cleveland) and the less urban parts of the study area. Western Europe, the USA and Far East each account for about a third of the total number of jobs promised (less than two per cent of the promised jobs originate from elsewhere). Only 13 per cent of the jobs are in plants outside the manufacturing sector (33 per cent of projects), but within the manufacturing sector two-thirds of the jobs are within the four main activities given above. The plant age in measured in years from the date of the initial plant establishment, so that it takes a value of zero for a start-up plant, while 37 per cent of the plants are Multiple Investors over the sample period. There is information on some other characteristics of the plants, *OTH1* to *OTH6*, which include details of plant status and changes occurring both over and subsequent to the study period.[9]

The project variables are the project date (*YEAR*); the project type according to whether it is a start-up, an acquisition, a joint venture or a re-investment (*TYPE*); the proposed number of project jobs (*JOB*); the receipt of non-financial assistance from the inward investment agencies and their predecessors, *Invest UK* (*IUK*) and the Regional Development Agency (*RDA*); the receipt of central government financial assistance, Regional Selective Assistance (*RSA*); and the annual growth rate in UK Gross Domestic Product (*GDP*). The investment scale (not shown) is known for only 252 projects, but where known there is a close relationship with the number of project jobs.[10] Assistance from the inward investment agencies could include a location search, the organization of a regional tour, a presentation tailor-made to the firm or where a promotional event or activity was held, although there is no indication that this influenced the firm's location decision. Details of Regional Selective Assistance were collected from published sources, but the Department of Trade and Industry made available details of unpublished cases on the same basis. These were matched to the project details, which compares very well with the other studies that have carried out similar matching exercises over recent years, but for much larger datasets (eg. Devereux *et al*, 2001; Harris and Robinson, 2001).

4: Re-investment

Throughout the analysis a distinction is drawn between two kinds of investment and two kinds of plant. First of all, a distinction is drawn between an Initial and a Subsequent investment. An Initial investment is the project by which a plant commenced in foreign ownership in the region over the period 1985-98, while a Subsequent investment is any further investment project carried out by the plants over the same period. Second, a distinction is made between a Multiple and a Single Investor. All plants carry out an Initial investment over the period 1985-98, but a Multiple Investor carries out at least one Subsequent project over this period, whereas a Single Investor does not carry out any Subsequent investments. The number of Multiple Investors that are associated with each plant type is given in Table 1. This table also shows that the majority of the Subsequent investments are re-investments, although not all, which is taken up below.

The analysis of re-investment begins by examining the characteristics of the plants that carry out at least one further investment after the Initial investment, ie. the Multiple Investors. It is conducted for the plants that commenced in foreign ownership over 1985-98 and remain open to the middle of the year 2000. Initially, the re-investment probability is examined. Allowance is made for the fact that the recently-established plants are less likely to be Single Investors, ie. they may not have had the opportunity to carry out a Subsequent investment. The duration to the first re-investment project is then examined, which has the advantage that censoring of the data can be more easily handled. In principle, the two kinds of analysis are distinct, but in practice the results suggest that a plant that has characteristics associated with a higher probability of re-investment also tends to carry this out investment sooner rather than later.

4.1 The Probability of Re-investment

The probability of re-investment is a conditional probability: P(*SI* | *II*), where *SI* = Subsequent investment and *II* = Initial investment. By Bayes Rule this is equal to P(*SI* ∩ *II*) / P(*II*), and since a plant carrying out an Initial and Subsequent investment is a Multiple Investor, then it can be written as P(*MI*) / P(*II*), where *MI* = Multiple Investor. Hence, the probability of re-investment is the probability that a plant is a Multiple Investor divided by the probability that it undertakes an Initial investment. The logit model to be estimated can therefore be written as:

$$P(MI) = \exp(\beta x - y_t) / \{1 + \exp(\beta x)\} \qquad (1)$$

where P(*MI*) takes a value of unity if the plant is a Multiple Investor, but zero for a Single Investor, x is a vector of variables on plant characteristics with coefficients β and y_t is an offset. The offset picks up the probability of a plant carrying out an Initial investment in each year t, ie. P(*II*) = $\exp(y_t)$. From our dataset, this is calculated as the number of Initial investments in each year t relative to that for the study period as a whole. It is intuitive, as if the probability of a plant undertaking an Initial investment is small then the probability that it turns out to be a Multiple Investor is also likely to be small. To capture the different time durations over which the plants are observed, year dummies are included in the estimation, but not reported.[11]

The logit model is regressed across plants, and variables are included in the x to capture the plant characteristics and influence of policy. These variables are given in Table 2, and where measured at the project level they refer to the Initial investment. The characteristics are the nature (*TYPE*), location (*COUNTY*), activity (*SECTOR*, *MANUF*) and country of origin (*ORIGIN*) of the plant. The policy terms are Regional Selective Assistance (*RSA*) and *Invest UK* (*IUK*), but the Regional Development Agency term (*RDA*) is omitted as all plants receiving assistance from this source are Multiple Investors, so that they predict the dependent variable with perfect success. In the case of the acquisition plants, the *IUK* term perfectly predicts the Multiple Investors. The *OTH* terms are included as controls, and like the above terms they are interpreted *ex-post*.[12]

The other terms that are included are the plant age (*AGE*) and scale (*JOB*), and the growth rate in output (*GDP*). As rationales for the inclusion of these terms, the expectation is that older plants are less likely to re-invest, and that the economic conditions on entry may affect a plant's performance, including re-investment. Plant scale is measured by the number of proposed jobs, for which more or less complete data exists, but the relationship may be quite complicated. On the one hand, it could be argued that the large plants are already large and have no need to re-invest. On the other hand, larger plants may have a greater capacity to raise funds and re-invest, or to stage their investment projects over time. For this reason, a quadratic *JOB* term is included, and some exploration is undertaken below between small and large plants.

The analysis is carried out for all open plants, on which there are 191 observations, but separately for the start-ups (113 observations) and acquisition plants (63). Table 3 reports the results from estimating (1). The baseline plant is a joint venture in Northumberland, operating in the Rest of Manufacturing outside the four main activities and originating from Western Europe (plants originating from the Rest of the World are all Single Investors). The marginal effects are evaluated at the variable means. In the case of all plants the predicted probability of re-investment is 0.393, which is close to the actual probability that a plant is a Multiple Investor of 0.405, but there are strong differences between the plant types. The predicted re-investment probability for a start-up (that otherwise has baseline characteristics) is 0.417, but for an acquisition it is 0.048, so that the results for these different types are considered separately.

The results show that start-up plants have a much higher re-investment probabilities in three of the four main manufacturing activities, as do the plants in receipt of financial assistance in their Initial investment. The coefficients on the *JOB* terms indicate that the re-investment probability increases up to an initial plant scale of around 700 jobs, but that it then decreases, and the reasons for this were considered above. Plants with other plants in the region have higher re-investment probabilities, as do those plants that relocate (which may be part of the relocation), but plants that have other plants at the same site have lower re-investment probabilities, possibly due to capacity constraints. In the case of the acquisitions the results suggest that these plants are far less likely to re-invest in the more metropolitan areas, possibly because these older and much more established operations, while plants outside manufacturing also have lower re-investment probabilities. Re-investment also decreases with the age of the plant. The size of the plant is also important, and re-investment increases up to an initial plant scale of around 750 jobs.

4.2 The Re-investment Duration

The period of time between the Initial investment and the first Subsequent investment is now modeled, and the characteristics that lead a plant to re-invest sooner rather than later are examined. The time origin is the year of the Initial investment when the plant commenced in foreign ownership over 1985-98, either as a start-up, an acquisition or as a joint venture. The Single Investors do not re-invest at all over this period, so that these represent censored observations, but they form a part of the analysis. The hazard rate is the probability that a firm becomes a Multiple Investor given that it has not already done so, and the survival rate is the probability that a plant gets to 1998 without becoming a Multiple Investor, so that it is a Single Investor.

The empirical hazard rates are evaluated by year in Table 4.[13] For all plants, these hazard rates are generally in the range 7 to 10 per cent up to seven years after the Initial investment, but much lower for observed durations of eight or more years. Indeed, there are only four plants with an observed duration to the first re-investment of eight years or more, so that a plant either carries out its first re-investment within seven years or not at all. A similar pattern exists for the start-ups, but the acquisition plants have hazard rates that are initially much higher, at between 10 and 13 per cent in the first two years, but which are generally zero after five years. It suggests that after acquisition the inward investor either puts its specific technology into place soon afterwards or not at all.

To proceed to estimation, the log-likelihood function is written as follows (see Lawless, 1982 and McCloughan and Stone, 1996):

$$\text{Log}\, L \;=\; \Sigma_i\, \delta_i\, h(t_i) \;+\; \log S(t_i) \qquad (2)$$

where $h(t_i)$ and $S(t_i)$ are the hazard and survival functions respectively, and δ_i is an indicator variable that takes a value of unity if the time period between the Initial and Subsequent investment is observed (ie. the observation is not censored).

Equation (2) is estimated using maximum likelihood techniques for each of the Weibull, lognormal and log-logistic distributions. For all plants, the start-ups and the acquisition plants, the competing distributions gave similar estimates of the covariates, ie. the β on the x, (the results for the Weibull model are in an accelerated failure-time form and directly comparable with each of the other two models), but different results for the form of the hazard function. The shape parameter for the Weibull implies positive duration dependence, while log-logistic rejects negative duration dependence in favour of an increasing and then decreasing hazard rate, which is also imposed by the lognormal distribution. The Weibull and log-logistic distributions are non-nested, but the latter is preferred for several reasons. First, the log likelihoods tend to be slightly higher for the log-logistic distribution, which suggests that it should be preferred under the Akaike information criterion.[14] Second, the Weibull model is nested in the generalised gamma model, but it is rejected by this model at the one per cent level (the lognormal distribution is also rejected but at the five per cent level). Third, the Weibull distribution can be examined by regressing the 'log-log plot' (see Wren and Storey, 2002), but it does not provide strong support for this model.[15]

Finally, positive duration dependence seems implausible, as it confounds the evidence for the empirical hazard rates in Table 4, implying that the probability of re-investment increases the longer is the period of time from the Initial investment.[16] Since the ancillary parameter for the variance of the lognormal distribution is insignificant and it is rejected by the Gamma distribution, then the log-logistic distribution is preferred. The results for this are presented in Table 5. In each case, the shape parameter κ is significantly greater than unity, suggesting an increasing and then decreasing hazard rate (see Greene, 2003, chapter 22). There are two ways of interpreting these estimates. The first is to examine the median re-investment duration, which for the log-logistic model is equal to exp (βx). The second is to differentiate the hazard function, to find the time duration at which the hazard rate reaches a maximum. This is equal to $t^{max} = (\kappa - 1)^{1 / \kappa} \exp (\beta x)$, so that t^{max} is equal to the median re-investment duration multiplied by $(\kappa - 1)^{1 / \kappa}$.[17] Evaluating $(\kappa - 1)^{1 / \kappa}$ using the estimates shown in Table 5 gives values that are close to unity (0.89, 1.29 and 1.07 for all plants, the acquisition and start-ups plants respectively), so that these give similar results.

In regressing (2) the covariates x and the baseline case are the same as before. As a first point, the estimates in Table 5 suggest that the median duration for a baseline plant is very large, but this is because the plants from the Rest of the World are all Single Investors. For all plants the regression shows that the acquisitions have significantly shorter re-investment durations than other plants. In the case of these acquisitions the durations are relatively longer in the metropolitan areas, and it was found above that these plants have lower re-investment probabilities. The policy terms are insignificant throughout. In the case of the start-ups relatively few of the covariates are significant, but the coefficients on the *JOB* terms suggest a non-linear pattern related to the initial plant scale. In this case, the re-investment duration decreases to a plant size of around 880 jobs, which is similar to that obtained from the logit analysis. The *JOB* term was also entered in logarithmic form, but the quadratic form is preferred.[18] Reflecting this pattern, (2) was also regressed separately for the Small and Large start-up plants, which respectively are plants with no more than, and greater than 50 jobs in the Initial investment. This roughly divides the sample into two. The quadratic *JOB* term is not included and the results are also given in Table 5. They indicate a longer re-investment duration for the very small plants, but which decreases with plant size.

The median re-investment durations for different plant sizes are evaluated in Table 6 based on the estimates for all start-up plants shown in Table 5. These are calculated for a start-up plant originating from each of the Far East, the USA and Western Europe, although the estimates for these are not significantly different (χ^2 (2)= 1.25). The results from estimating (2) with a linear *JOB* term are also given for the purpose of comparison. It shows that the re-investment duration decreases at a decreasing rate with the project job size, from about 10-16 years for very small plants to around 3 to 5 years for a plant promising 500 jobs on entry. It reaches a minimum for a plant promising around 880 jobs but then increases very sharply to 23-40 years for a plant promising 1,000 jobs. It suggests that the extremely large plants on entry do not re-invest at all, although the number of these plants is small, so that in effect the re-investment duration decreases with plant size in practice.[19] The linear *JOB* term produces similar durations, except for the very large plants.

5: Survival

Using the definition of a plant outlined above, plant survival is investigated at the middle of the year 2000. Of the 265 plants commencing in foreign ownership in the North-East region over 1985-98, 50 (18.9 per cent) had closed by this time (see Table 1). This failure rate is similar for the start-ups (21.3 per cent) and for the Small and Large start-up plants, as defined above (25.6 and 19.7 per cent respectively). However, the loss of prospective job in the Large start-up plants is of greatest significance, as these account for over 90 per cent of the job losses in the start-up plants (ie. 6,916 of the 7,533 jobs), and over 70 per cent of all job losses in plants commencing over 1985-98.

Firm survival is examined by modelling the time duration to failure at 2000. There are two types of data censoring, as not only is the actual lifetime of a plant that survives to 2000 not known, but for the non-survivors the lifetime is also not known, as it is observed only that the plant did not survive until 2000. The log-likelihood function L is of the form:

$$\text{Log}\,L \;=\; \Sigma_i\, \delta_i\, [1 - S(t_i)] \;+\; (1 - \delta_i) \log S(t_i) \qquad (4)$$

where the survival function $S(t_i)$ gives the probability that a plant survives to time t, and the indicator variable δ_i takes a value of unity if plant i is closed at 2000, but otherwise zero. The time origin is the date at which a plant commenced in foreign ownership. Again, it is estimated for each of the Weibull, log-logistic and lognormal distributions, where the regressors and baseline case are the same as before. A plot of the hazard rates for the competing distributions gives very similar results (not reported), implying positive duration dependence over 1985-98. However, in the case of the Weibull model the shape parameter is significantly greater than 2, suggesting that the hazard rate increases at an increasing rate with the observed duration, which is implausible. The other models were similar and more plausible, of which the log-logistic distribution was preferred.

The results from maximising (4) with the log-logistic survival function are shown in Table 7. The first column of this table gives the estimations for all plants, while the other columns give the results for the start-ups only, with a breakdown between the Small and Large start-up plants (as defined above). In total, there are 265 plants (both open and closed), but the number of jobs in the Initial investment (*JOB*) is not known for 29 plants, giving 236 observations (Table 2). Similarly, project jobs are not known for 17 of the 164 start-up plants, giving 147 observations. The quadratic *JOB* term is insignificant in all cases, so that this is omitted from the regressions.[20]

The results for all plants in Table 7 suggest there is no significant difference in the pattern of closure between the three plant types (start-ups, acquisitions and joint ventures). It is consistent with the similar failure rates reported above, and the results for the start-up plants are very similar to those for all plants. While many of the covariates are insignificant, the results suggest that a plant is more likely to survive if in receipt of RSA in its Initial investment, while plants having involvement with *Invest UK* survive throughout the study period. The plant scale term *JOB* is insignificant, while many of the *OTH* terms are significant, although some of these relate to events after 1998. However, it is not believed that this is problematic, and the results are unchanged when they are omitted.

The last two columns of Table 7 report the results when (4) is maximised separately for the Small and Large start-up plants, and indicate important differences between these. The Small start-ups have much longer survival durations in certain activities and areas, as do those that receive non-financial assistance from the Regional Development Agency in their initial project. The estimates of the shape parameter κ are generally large, but especially so in the case of the Large plants, which means that the hazard rate increases extremely sharply after some period of time. Again, for the Large plants there are significant variations in survival between different activities and areas, while plants from the Far East, and particularly the USA, have much shorter durations. Large plants having involvement with the RDA have shorter durations, and the survival duration decreases with plant size (this latter effect is very strong with a z-value of 41.8). Finally, the better are economic conditions when the plant establishes itself the greater is the plant's survival duration.

The plant survival rates and median survival durations are calculated in Table 8 for the start-up plants based on the results for start-ups given in Table 7. These are for a plant in Tyne and Wear originating from the Far East, but which otherwise has baseline characteristics. The survival rates are evaluated for all plants and for the Small plants, but in the case of the Large plants they are evaluated for three different plant job scales. Overall, the median survival duration is about 10 years and this is also the case for the Small plants. However, in the case of the Large plants it decreases with plant size, from about 12 years for a plant promising 100 jobs to 8 years for a plant promising 1,000 jobs. The striking pattern from the table are the very high hazard rates that set in after some time, reflecting the relatively high estimated values of the shape parameter in Table 7. Overall, the table shows that 95 per cent of foreign-owned start-up plants survive for 5 years, but that after 10 years the survival rate is 0.52, and that after 15 years it is only 0.16. There is little difference for the Small plants, but the gradients are much steeper for the Large plants, which have extremely high closure rates that set in around the time of the median survival duration.

These results on plant survival find support elsewhere in the literature, which is reviewed in McCloughan and Stone (1998). These authors find strong support for an increasing and decreasing hazard rate, and this has been found both in the case of new small entrants (Holmes *et al*, 2000) and all new entrants (Audretsch and Mahmood, 1994). McCloughan and Stone also find that the hazard rate for foreign multinational subsidiaries peaks at about 8 years, and that in the case of start-up plants a parametric analysis suggests it is 12 years. These are longer than the hazard rates found by some others, such as Li (1995), but they seem to accord with a common perception that the life of an inward investment plant is on average about ten years.

6: Plant Embeddedness

The previous sections examined the re-investment probability and the re-investment survival time duration of the Multiple Investors, as well as the survival durations of both Multiple and Single Investors. The issue that is now addressed is whether re-investment by Multiple Investors embeds these plants, leading to significantly longer survival patterns from the time of the first re-investment and relative to that of the Single Investors. There are a sufficient number of observations with which to examine this issue, as Table 1 shows that 37.0 per cent of all plants are Multiple Investors (98 of the 265 plants), and that this is similar for the start-ups (39.0 per cent). The proportion of surviving plants that are Multiple Investors are higher, at 40.5 and 43.4 per cent respectively, suggesting that the Multiple Investor plants have higher survival rates.[21] Attention is restricted to the start-up plants, as it was found that there was no difference in the pattern of closure between these and all plants.

As an initial step, (4) was re-estimated for the start-up plants, keeping the time origin as the date of the Initial project in all cases, but including *MULTIPLE* as an additional covariate (see Table 2). The results for the start-up plants (not reported) give an estimated coefficient on *MULTIPLE* of 0.411, with a z-value of 2.95. This indicates that the median survival duration of a Multiple Investor is about 1.51 times that of a Single Investor (ie. exp 0.411). Evaluating the coefficients, the median survival duration for a Single Investor is 8.8 years but 13.3 years for a Multiple Investor. These may be compared with an overall survival duration of 10.2 years shown in Table 8. A similar pattern exists for the Small start-up plants (the ratio is 1.63 and the survival durations are 9.1 and 14.9 years respectively), but there is a much smaller difference for the Large start-ups, where the ratio is only 1.21. Thus, at an initial plant size of 100 jobs the median survival durations are 11.1 and 13.4 years respectively, and for a plant size of 1,000 they are 7.2 and 8.8 years.

By themselves, these ratios of the median survival durations for the Multiple and Single Investors do not provide strong support for embeddedness arising from re-investment. In particular, the survival duration from re-investment increases by only about one-and-a-half fold, while for the Large plants the ratio is much smaller. To get a handle on this, Table 6 shows the median duration to the first re-investment for a start-up plant promising 100 jobs is in the order of 8 years, but the survival duration for a plant this size that re-invests increases by only about 2 years from 11 to 13 years. It certainly does not suggest that a Subsequent investment should be prized more highly than an Initial investment carried out by a plant with similar characteristics at the same time.

As a further examination of embeddedness, (4) was re-estimated for the start-up plants, but with the time origin taken to be the date of the first re-investment project. As before, the time origin for the Single Investors is the date of the Initial project. In some ways this provides a better test of embeddedness, as the Multiple Investors may potentially carry out many Subsequent investments over time, while Table 1 shows that not all the Subsequent investments are re-investments (although they virtually all are). This approach explicitly models the time duration from the date of the first re-investment. Again, to test for differences in survival between the Multiple and Single Investors the *MULTIPLE* term is included. The results for the start-ups are reported in Table 9, with separate estimations for the Small and Large plants.

For all plants, the estimation results in Table 9 imply a median survival duration of about 7.4 years compared with 10.2 previously, as shown in Table 8. It reflects the fact that the time origin is now measured from the date of the first re-investment in the case of the Multiple Investors. The results are similar to those obtained previously in Table 7, but except for the Large start-up plants, and possibly reflecting the higher proportion of Multiple Investors in the Large plants (see note 21). However, the coefficients on *MULTIPLE* are insignificant in each case, with respective z-values of 0.76, 0.58 and 0.74 for the results shown in Table 9. It suggests that the median survival duration of a Multiple Investor from the date of the first re-investment is no different to that of a Single Investor carrying out an Initial start-up investment at the same date. Again, it fails to provide any support for re-investment as a source of embeddedness.

Finally, the parametric methods used above restrict the shape parameter κ in the log-logistic distribution to be the same between the Multiple and Single Investors, but it is possible that it may vary between these plants. Tests for embeddedness were also carried out using non-parametric and semi-parametric methods. In the case of the former, a Wilcoxon test indicated significant differences in the empirical survivor functions between the Multiple and Single Investors when the time origin for the former was taken to be the date of the Initial investment ($\chi^2(1) = 21.04$). However, when the time origin for the Multiple Investors was the date of the first re-investment there was no significant difference ($\chi^2(1) = 1.22$). In the case of the semi-parametric method, a Cox proportional hazards model was estimated but stratified to allow the baseline survivor function to differ between the Multiple and Single Investors. A Chi-square test indicated that there was no statistical difference in the baseline survival functions ($\chi^2(13) = 2.30$).

7: Conclusions

The high failure rate of large foreign-owned plants and the consequences for employment have focused attention on the ways in which the economic development agencies can embed the plants in the local economy in order to forestall closure. The purpose of this paper has been to examine re-investment as a source of embeddedness, leading to higher survival time durations. Re-investment is potentially important, as it signals the commitment of a company to sustain its operation, and it offers an identifiable lever by which the development agencies can embed these plants. The study utilizes a unique dataset on inward investment that has been constructed by the authors for the North-East of England over the period 1985-98. The data are project-based, which means that discrete re-investment projects can be identified involving a significant enhancement to a plant's operating capacity, including an expansion of plant scale. The paper focuses on new foreign-owned start-ups, ie. 'greenfield' investments.

Overall, the paper does not find strong evidence for re-investment as a source of plant embeddedness. The plants that re-invest (the Multiple Investors) have longer survival durations, but these are much the same as the survival time durations of new plants starting-up at the same time with similar characteristics. The median survival duration of a Multiple Investor is found to be about 1.5 times that a plant that does not re-invest, but this ratio is smaller for larger plants at about 1.2. For all start-up plants, the median survival duration of a Multiple Investor is 13.3 years, compared with 8.8 years for other plants (and 10.2 years overall), but for the larger plants the respective figures may differ by only 2 to 3 years. The large plants are associated with the majority of the job losses. It suggests that re-investment does not substantially extend the life of a foreign-owned plant, and that the development agencies should not focus on this kind of project at the expense of new investment. Further, it suggests that plants either look for a quick payback period on their re-investments or their plans are overtaken by events, which leads to unforeseen closures. Either way, the paper does not provide support for re-investment as a source of plant embeddedness, although it does not close down other options for embedding these plants.

Notes

1. The headlines are taken from the *Guardian* newspaper over 2000-02. They represent 10,000 job losses, but are only a sample of foreign-owned plant closures over this period.

2. To obtain these data the RDA relies on its dealings and contacts with inward investors, but also local, regional and national agencies and government offices, and the scrutiny of the local and national media. The RDA supplied information on 569 projects over 1985-98.

3. Start-up projects are often referred to as 'greenfield' investments, although this is misleading as a new plant could establish itself at an existing industrial site. Acquisitions are defined as projects where a foreign company takes more than a 50 per cent stake in a UK company, which also includes mergers. A joint venture is where a foreign-owned firm has at least a 50 per cent stake, possibly with another foreign-owned firm. A re-investment is a project after the initial investment by which the plant commenced in foreign ownership.

4. There may be some missing data on the smaller projects, but this is unlikely to affect the representativeness of the data. Jones and Wren (2002b) find that the jobs promised by the inward investors are realized in plant employment, suggesting that the re-investment projects are complete, although the larger plants are less likely to reach their job targets

5. In addition to determining the links between projects in order to organize the data on a plant basis, the exercises included determining whether the plant had commenced in the first place and whether it had survived, as well as checking and improving the coverage of the data. The exercises took about nine months to complete, and included consulting various computerized and other business directories, interviews with regional, county and sub-county agencies, and telephone surveys of inward investors and firms in related activities. Virtually all the plants had gone ahead in some form.

6. Like other definitions of a plant it is not free of ambiguities, but these should not be over-stated as they are of limited significance. It offers a simple way of assigning projects to plants and for classifying a plant as open or closed. A foreign-owned plant that anglicizes its name after establishment or relocates within the region is regarded as the same plant, but a plant that moves outside the region (possibly overseas) is a closure. A plant is treated as on-going even if is later taken over, perhaps by another foreign-owned plant, as the assets that were provided continue in productive use in the region.

7. The other 72 plants established themselves prior to 1985, but the data are truncated for these plants as only the re-investing plants and the Subsequent investments are observed. At 1999 there are estimated to be a total of around 475 foreign plants in the region.

8. The dataset from which the data are drawn give greater detail on the included variables (eg. the 4-digit coding of the plant activity and country of origin) and some other variables (eg. the end-of-period employment and the amount of Regional Selective Assistance), but these are sufficient for our purpose.

9. Data on the *OTH* variables were not collected on a systematic basis, and they are included as controls. Table 2 shows that 14 per cent of the plants have other plants in the region and 6 per cent relocated, but that the other categories include only a small number of plants. The last three of the *OTH* variables include events occurring after the end of the study period at 1998, but before plant survival is measured at 2000.

10. The correlation coefficient between these is +0.66, which increases to +0.71 when a small number of very large and highly capital-intensive projects are excluded.

11. The offset captures the fact that there may be more Initial investments occurring in some years relative to others. The year dummies perform a different job, and are included because recently-established plants are less likely to be observed re-investing.

12. There are no observations on *OTH6* for the open plants, while *OTH4* perfectly predicts the Multiple Investors in the case of the start-up and acquisition plants, and is therefore omitted.

13. The empirical survival function $S(t)$ can be found from the empirical hazard rates, using the product-limit method, $S(t) = \{1 - h(t)\}\ \{1 - h(t - 1)\}\ \ldots\ \{1 - h(1)\}$ (see Lawless, 1982, pp. 53-71). They are plotted in Jones and Wren (2002a) and they confirm the impression from the empirical hazard rates.

14. Since the numbers of covariates and model-specific ancillary parameters are the same, the Akaike information criterion amounts to choosing the model with the highest log likelihood.

15. For plants with similar covariates x the 'log-log plot' means that the plot of $\ln [-\ln S(t \mid x)]$ against $\ln t$ should be linear, where $S(t)$ is the empirical survival function and t the observed duration. When regressed with 13 observations good results are obtained: the coefficient of determination is equal to 0.97 and estimated coefficients for the constant term and $\ln t$ are – 2.301 (29.5) and 0.865 (21.6) respectively (t-ratios in parentheses). The coefficient on $\ln t$ suggests negative duration dependence, but when a quadratic term in $\ln t$ is added it is also significant, which does not support the Weibull distribution.

16. When the longer time durations are omitted, the estimated shape parameter is in excess of 2, which is even more implausible, implying a hazard rate that increases at an increasing rate.

17. The log-logistic hazard function is $h(t) = (\lambda\ \kappa)\ (\lambda\ t)^{\kappa - 1} / [1 + (\lambda\ t)^{\kappa}]$, where κ is the shape parameter. It is parameterized by setting $\lambda \equiv \exp(-\beta x)$. Differentiating this with respect to t gives $t^{max} = (\kappa - 1)^{1/\kappa} \exp(\beta x)$.

18. The log-likelihoods from estimating (2) for the start-up plants with the *JOB* term expressed in quadratic, linear and logarithmic and form are -76.6, -77.8 and -79.1 respectively.

19. Omitting the start-ups promising more than 880 jobs in their Initial investment gave virtually identical estimates. To maximize the number of observations the equation was estimated for all plants, both open and closed, but broadly similar results were obtained. This was also the case when the time duration was measured to the first Subsequent investment involving at least some new jobs (rather than both new and safeguarded jobs).

20. Including the *JOB* term in quadratic form for all plants the z-values on *JOB* and JOB^2 are 0.08 and 0.69 respectively. Including *JOB* in logarithmic form did not improve the results.

21. The proportion of Small and Large start-up plants that are Multiple Investors are 32.0 and 50.8 per cent respectively, which are higher for surviving plants (37.5 and 53.1 per cent).

Table 1: The Relationship between Plant and Project Types

	All Plants	Start-ups	Acquisitions	Joint ventures
Number of plants	**265**	**164**	**79**	**22**
Number of projects	**416**	**260**	**121**	**35**
Of which:				
Initial project	265	164	79	22
Subsequent projects:	151	96	42	13
re-investments	(140)	(90)	(38)	(12)
acquisitions	(9)	(5)	(3)	(1)
joint ventures	(2)	(1)	(1)	(0)
Number of Multiple Investors	**98**	**64**	**26**	**8**
Number of closed plants	**50**	**35**	**12**	**3**

Note: The table shows the number of Initial and Subsequent investment projects carried out by plants of each type. Multiple Investors are plants carrying out at least one Subsequent investment project (both open and closed). Plant closure refers to the middle of the year 2000.

Table 2: The Variables

	Number	Min.	Max.	Mean	CV
(i) The Plant variables	265				
COUNTY - county location	265	1	4	-	-
SECTOR - sectors outside of manufacturing	265	0	1	0.32	-
MANUF - manufacturing activity	265	1	5	-	-
ORIGIN - country of origin	265	1	4	-	-
AGE - age of plant, measured in years	259	0	136	8.1	2.51
MULTIPLE – plants with more than one project	265	0	1	0.37	-
OTH1 - other plants in region with same owner	265	0	1	0.14	-
OTH2 - other possibly related plants at same site	265	0	1	0.02	-
OTH3 - the plant has relocated	265	0	1	0.06	-
OTH4 - foreign-owned takeover of plant after 1998	265	0	1	0.03	-
OTH5 - UK takeover or buyout of plant after 1998	265	0	1	0.04	-
OTH6 - reopening of plant after closure after 1998	265	0	1	0.02	-
(ii) The Project variables	416				
YEAR - calendar year of project	416	85	98	92.0	0.002
TYPE - type of project	416	1	4	-	-
JOB - proposed number of project jobs	384	0	3,000	150.4	1.76
IUK - involvement by *Invest UK*	416	0	1	0.12	-
RDA - involvement by *One NorthEast*	416	0	1	0.26	-
RSA - receipt of RSA	416	0	1	0.29	-
GDP - UK growth rate of GDP (per cent)	416	-1.50	5.20	2.46	0.73

Table 3: Results for the Probability of Re-investment

	All plants Coeff.	$\partial p / \partial \beta$	Start-ups Coeff.	$\partial p / \partial \beta$	Acquisitions Coeff.	$\partial p / \partial \beta$
TYPE – Start-ups	0.868	20.7	-	-	-	-
TYPE – Acquisitions	1.092	26.0	-	-	-	-
COUNTY – Tyne & Wear	-1.302	-31.1	-1.832	-44.5	-9.634***	-44.0
COUNTY – Durham	-0.589	-14.1	-1.062	-25.8	-4.028	-18.4
COUNTY – Cleveland	-1.487	-35.5	-1.243	-30.2	-7.672***	-35.1
SECTOR	-0.265	-6.3	-1.318	-32.1	-8.276***	-37.8
MANUF – Chemicals	0.481	11.5	3.456**	84.0	-3.056	-14.0
MANUF – Machinery	-0.964	-23.0	3.971**	96.5	0.744	3.4
MANUF – Communications	1.032	24.7	3.353**	81.5	3.445	15.7
MANUF – Transport	1.391*	33.2	2.854	69.4	-	-
ORIGIN – Far East	1.447**	34.6	1.363	33.1	6.065***	27.7
ORIGIN – USA	-0.960	-22.9	-2.267	-55.1	-1.542	-7.0
RSA	3.308***	78.9	5.141***	125.0	1.032	4.7
IUK	1.648*	39.3	0.125	3.1	-	-
OTH1	1.295*	30.9	7.223***	175.6	-0.638	-2.9
OTH2	-0.529	-12.6	-2.433*	-59.1	-	-
OTH3	0.686	16.4	2.789*	67.8	7.191***	32.9
OTH4	3.537**	84.4	-	-	-	-
OTH5	3.019***	72.0	2.577*	62.6	9.241***	42.2
AGE	-0.035	-0.8	-	-	-0.105**	-0.5
JOB	0.022***	0.5	0.031**	0.8	0.038***	0.2
JOB^2 (x10^{-3})	-0.033***	-0.8	-0.044**	-1.1	-0.051***	-2.3
GDP	-0.321	-7.7	-0.808*	-19.6	0.885	4.0
Constant	-4.591		-2.787*		-1.977	
N	191		113		61	
LogL	-62.72		-32.84		-10.84	
Pseudo R^2	0.48		0.58		0.67	
Wald (χ^2)	61.75***		62.64***		40.33***	
predicted P(*MI*)	0.393		0.417		0.048	

Notes: ML estimation of (1). Description of the variables is given in Table 2 and the baseline case in the text. The regressions include yearly time dummies (not shown), but omit *RDA*, *ORIGIN* (Rest of the World) and *OTH6* for the reasons given in text. For each regression, $\partial p / \partial \beta$ is the marginal effect times 100, calculated at the variable means. Robust standard errors based on the parameter estimates. *** = significant at the one per cent level, ** = five per cent and * = ten per cent.

Table 4: Empirical Hazard Functions for Multiple Investment

Duration	All Plants		Start-ups		Acquisitions	
(years)	$h(t)$	no.	$h(t)$	no.	$h(t)$	no.
1	7.81	(192)	6.19	(113)	12.90	(62)
2	9.76	(164)	10.00	(100)	10.64	(47)
3	9.60	(125)	8.86	(79)	6.06	(33)
4	7.77	(103)	9.23	(65)	3.45	(29)
5	7.32	(82)	7.69	(52)	4.55	(22)
6	7.58	(66)	9.30	(43)	0	(17)
7	8.93	(56)	8.11	(37)	7.14	(14)
8	2.44	(41)	3.33	(30)	0	(7)
9	0	(33)	0	(26)	0	(4)
10	9.52	(21)	5.88	(17)	50.00	(2)
11	7.69	(13)	9.09	(11)	-	(0)
12	0	(7)	0	(5)	-	(0)
13	0	(6)	0	(4)	0	(1)

Note: The hazard rate (expressed as a percentage) is the probability that a plant becomes a Multiple Investor given that it has not already done so. The figures in parentheses are the number of observations on which the calculation of each hazard rate is based.

Table 5: Results for the Re-investment Duration

			All Plants	Acquisitions	Start-ups		
					All	Small	Large
TYPE	–	Start-ups	-0.308	-	-	-	-
TYPE	–	Acquisitions	-0.881**	-	-	-	-
COUNTY	–	Tyne & Wear	0.751**	3.727**	0.232	2.451***	0.135
COUNTY	–	Durham	0.620*	0.461	0.198	2.742***	-0.321
COUNTY	–	Cleveland	0.907**	1.640***	0.322	1.752***	0.579
SECTOR			0.332	1.279*	0.234	0.582	-0.548
MANUF	–	Chemicals	-0.157	0.364	-0.701	0.405	0.141
MANUF	–	Machinery	0.246	-1.717	-0.112	-0.307	0.471
MANUF	–	Communications	0.357	-2.646	0.256	2.427***	-0.421
MANUF	–	Transport	-0.667**	0.956	-0.734*	0.918*	-0.732
ORIGIN	–	Far East	-9.000***	-5.656***	-7.736***	-5.947***	-0.543
ORIGIN	–	USA	-8.257***	-3.829*	-7.191***	-5.259***	0.076
ORIGIN	–	Western Europe	-8.456***	-3.571	-7.489***	-5.843***	-
RSA			0.037	3.238	0.015	-0.379	0.023
IUK			-0.382	-5.663	0.407	-0.530	-1.199
RDA			-0.307	-9.203	-0.029	-0.666	0.400
AGE			0.017	0.015**	-	-	-
JOB (x 10^3)			-5.424**	-13.733	-6.063**	-28.853***	0.077
JOB (x 10^6)			7.520*	29.300	6.873*	-	-
GDP			-0.097	-0.345**	-0.081	0.039	-0.146
Constant			11.016***	6.200**	10.070***	4.283**	2.332***
Shape parameter (κ)			1.870***	4.295***	2.189***	3.079***	2.576***
N			191	61	113	64	49
LogL			-136.2	-17.6	-76.6	-23.69	-39.46
Pseudo R^2			0.22	0.66	0.27	0.49	0.24

Notes: ML estimation of (2) with log-logistic distribution. The shape parameter is significantly greater then unity in each case. The *OTH* variables are included but not reported. One large outlier plant is dummied out in the case of start-up plants. Small = plants with less than or equal to 50 jobs in the Initial investment; Large = all other plants. Robust standard errors. *** = significant at the one per cent level, ** = five per cent and * = ten per cent.

Table 6: Median Re-investment Duration for Start-up Plants

JOB =	10	25	50	100	500	1000
(a) Quadratic *JOB* term						
Far East	9.7	8.9	7.8	6.0	2.8	23.1
USA	16.8	15.4	13.4	10.4	4.8	39.9
Western Europe	12.4	11.4	9.9	7.7	3.6	29.6
(b) Linear *JOB* term						
Far East	8.1	7.9	7.4	6.6	2.7	0.9
USA	11.7	11.3	10.7	9.6	3.9	1.3
Western Europe	10.5	10.1	9.6	8.5	3.5	1.1

Notes: Median re-investment durations (in years) are evaluated for different Initial project job sizes *JOB* and countries of origin, but otherwise the plants have baseline characteristics. Part (a) evaluates the durations for all start-up plants in Table 5 and part (b) after omitting the quadratic *JOB* term.

Table 7: Survival Results

		All plants	Start-up plants		
			All	Small	Large
TYPE –	Start-ups	-0.062	-	-	-
TYPE –	Acquisitions	-0.149	-	-	-
COUNTY –	Tyne & Wear	-0.241	-0.008	0.336*	0.096**
COUNTY –	Durham	-0.256	0.083	0.456*	0.347***
COUNTY –	Cleveland	-0.135	-0.116	0.071	0.275**
SECTOR		-0.309**	-0.298	-0.283	-0.003
MANUF –	Chemicals	-0.341	-0.090	3.279***	-0.370***
MANUF –	Machinery	0.038	-0.030	3.611***	-0.377***
MANUF –	Communications	-0.379**	-0.239	4.064***	-0.347***
MANUF –	Transport	0.224	0.078	-0.033	0.083
ORIGIN –	Far East	0.035	0.259	0.230	-0.055*
ORIGIN –	USA	-0.152	0.084	-0.083	-0.292*
ORIGIN –	Western Europe	0.057	0.270	0.149	-
RSA		0.409***	0.359**	0.556***	0.100
IUK		3.920***	3.235***	3.836***	0.977***
RDA		0.122	0.069	3.110***	-0.276*
OTH1		0.627**	0.365	0.351	0.879***
OTH2		4.174***	3.353***	2.676***	0.617***
OTH3		0.273	0.145	3.487***	0.265***
OTH4		3.952***	3.067***	-	0.280*
OTH5		4.242***	3.631***	4.171***	0.701***
OTH6		-0.181	-0.026	-4.225***	0.654***
AGE		-0.003	-	-	-
JOB (x 10^{-3})		0.041	-0.216	3.244	-0.499***
GDP		-0.019	0.003	-0.040	0.063***
Constant		2.854***	2.320***	2.025***	2.371***
Shape parameter (κ)		4.247***	4.844***	4.870***	57.38***
N		236	147	86	61
Pseudo R^2		0.33	0.35	0.47	0.28
LogL		-63.6	-41.8	-23.5	20.72

Notes: ML estimation of (4) with log-logistic distribution. Notes to Table 5 give definitions of Small and Large plants. The baseline plant for Large plants originates from Western Europe. The shape parameter is significantly greater then unity in each case. Robust standard errors. *** = significant at the one per cent level, ** = five per cent and * = ten per cent.

Table 8: Estimated Survival Rates for the Start-up Plants

Duration (t = *years*)	All plants	Small plants	Large plants		
***JOB*:**	**> 0**	**≤ 50**	**100**	**250**	**1,000**
1	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	1.00	1.00	1.00
3	0.99	0.99	1.00	1.00	1.00
4	0.98	0.99	1.00	1.00	1.00
5	0.95	0.97	1.00	1.00	1.00
10	0.52	0.57	1.00	0.75	0.00
15	0.16	0.16	0.00	0.00	0.00
Median duration:	**10.2**	**10.6**	**12.4**	**10.2**	**8.0**

Notes: The table calculates the survival rates for a start-up plant in Tyne and Wear originating from the Far East, but which otherwise has baseline characteristics. For duration t the survival rate is $S(t) = 1 / \{1 + (t / \exp \beta x)^{\kappa}\}$. The three parts of the table are based on the results for all, Small and Large start-up plants shown in Table 7. The number of jobs *JOB* refer to the Initial project. A growth rate of 2.5 per cent is assumed at the time of the Initial investment.

Table 9: Survival for Start-up Plants from the Time of Re-investment

		All	Small	Large
TYPE –	Start-ups	-	-	-
TYPE –	Acquisitions	-	-	-
COUNTY –	Tyne & Wear	0.172	0.257	-0.071
COUNTY –	Durham	0.307	0.405	1.401***
COUNTY –	Cleveland	0.126	0.052	0.600**
SECTOR		-0.168	-0.332	0.923***
MANUF –	Chemicals	-0.190	3.341***	-1.096
MANUF –	Machinery	-0.064	3.365***	0.164
MANUF –	Communications	-0.307	3.820***	-0.646***
MANUF –	Transport	0.193	-0.071	2.305
ORIGIN –	Far East	0.159	0.180	0.377
ORIGIN –	USA	0.025	-0.151	1.665
ORIGIN –	Western Europe	0.290	0.091	-
RSA		0.392**	0.547**	1.253*
IUK		3.852***	3.860***	2.522***
RDA		-0.348	2.819***	-2.500*
OTH1		0.215	0.137	1.710***
OTH2		3.921***	2.449**	2.846**
OTH3		-0.148	3.409***	0.152
OTH4		3.185***	-	-1.562
OTH5		4.130***	4.292***	2.441**
OTH6		-0.347	-4.343***	-0.634
JOB (x 10^{-3})		-0.251*	0.001	-0.271***
GDP		0.024	-0.041	0.192***
MULTIPLE		0.123	0.136	0.740
Constant		2.003***	2.189***	0.401
Shape parameter (κ)		4.296***	5.091***	31.99***
N		147	86	61
Pseudo R^2		0.30	0.45	0.34
LogL		-43.4	-21.1	15.05

Notes: ML estimation of (4) with log-logistic distribution for open and closed plants. The duration is measured from the time of the first re-investment for the Multiple Investors. Notes to Table 5 give definitions of Small and Large plants. The baseline Large plant originates from Western Europe. The shape parameter is significantly greater then unity in each case. Robust standard errors. *** = significant at the one per cent level, ** = five per cent and * = ten per cent.

References

Audretsch, D. and Mahmood, M. (1994), 'The Rate of Hazard Confronting New Firms and Plants in US Manufacturing', *Review of Industrial Organisation*, 9, 41-56.

Baden-Fuller, C. (1989) 'Exit from Declining Industries and the Case of Steel Castings', *Economic Journal*, 99, 949-69.

Bala, V. and Goyal, S. (2000), 'A Noncooperative Model of Network Formation' *Econometrica*, 68, 1181-1129.

Colombo, M. G. and Delamstro, M. (2000), 'A Note on the Relation between Size, Ownership Status and Plant Closure: Sunk Cost versus Strategic Size Liability', *Economics Letters*, 69, 421-7.

Delacroix, J. (1993), 'The European Subsidiaries of American Multinationals: An Exercise in Ecological Analysis', in S. Ghoshal and E. Wesney (eds.), *Organisational Theory and the Multinational Enterprise*, St Martin's Press, New York.

Devereux, M. P., Griffith, R. and Simpson, H. (2001), 'The Geography of Firm Formation', paper presented to the RES Conference, Durham University.

Dunne, T., Roberts, M. and Samuelson, L. (1989), 'The Growth and Failure of US Manufacturing Plants', *Quarterly Journal of Economics*, 104, 671-98.

Fothergill, S. and Guy, N. (1990), *Retreat from the Regions: Corporate Change and the Closure of Factories*, Jessica Kingsley, London.

Ghemawat, P. and Nalebuff, B. (1990), 'The Devolution of Declining Industries', *Quarterly Journal of Economics*, 105, 167-86.

Granovetter, M. (1985), 'Economic Action and Social Structure: The Problem of Embeddedness', *American Journal of Sociology*, 91, 481-510.

Greene, W. H. (2003), *Econometric Analysis*, fifth edition, Prentice Hall, New Jersey.

Harris, R. I. D. and Hassaszadeh, P. (2002), 'Plant Exits in UK Manufacturing, 1974-95: The Impact of Ownership Changes and Age Effects', *mimeo*.

Harris, R. I. D. and Robinson, C. (2001), 'DTI Industrial Support Policies: The Impact of Regional Selective Assistance and SMART / SPUR Schemes', *Final Report to the DTI, December*.

Holmes, P., Stone, I. and Braidford, P. (2000), 'New Firm Survival: An Analysis of UK Firms using a Hazard Function', *mimeo*.

Jones, J. and Wren, C. (2002a), *The Characteristics and Performance of Inward Investment: Evidence from the North-East of England*, unpublished manuscript.

Jones, J. and Wren, C. (2002b), 'Do Inward Investors Achieve their Job Targets?', paper presented to the ESRC Urban and Regional Economics Seminar Group, Preston, July.

Lawless, J. F. (1982), *Statistical Models and Methods for Lifetime Data*, John Wiley, New York.

Li, J. (1995), 'Foreign Entry and Survival: Effects of Strategic Choices on Performance in International Markets', *Strategic Management Journal*, 16, 333-51.

Maylor, H. (2003), *Project Management*, Pearson Education, Harlow.

McCloughan, P. and Stone, I. (1998), 'Life Duration of Foreign Multinational Subsidiaries: Evidence from UK Northern Manufacturing Industry, 1970-93', *International Journal of Industrial Organisation*, 16, 719-47

O'Farrell, P. N. and Crouchley, R. (1987), 'Manufacturing-Plant Closures: A Dynamic Survival Model', *Environment and Planning A*, 19, 313-29.

Phelps, N. and MacKinnon, D. (2000), 'Industrial Enclaves or Embedded Forms of Economic Activity? Overseas Manufacturing Investment in Wales', in *Contempory Wales*, vol 13, University of Wales, Cardiff.

Phelps, N., MacKinnon, D., Stone, I. and Braidford, P. (2003), 'Embedding the Multinationals? Institutions and the Development of Overseas Manufacturing Affiliates in Wales and North East England', *Regional Studies*, forthcoming.

Reynolds, S. S. (1988), 'Plant Closings and Exit Behaviour in Declining Industries', *Economica*, 55, 493-503.

Tomaney, J., Pike, A. and Cornford, J. (1999), 'Plant Closure and the Local Economy: The Case of Swan Hunter on Tyneside', *Regional Studies*, 33, 401-11.

Watts H. and Kirkham, J. (1999), 'Plant Closures by Multi-Locational Firms: A Comparative Perspective', *Regional Studies*, 33, 413-24.

Wren, C. (2002), 'UK Regional Policy: Does it Measure Up?', paper presented to the Alliance for Regional Aid Conference, Royal Institute of British Architects, London, April.

Wren, C. and Storey, D. J. (2002), 'Evaluating the Effect of Soft Business Support upon Small Firm Performance', *Oxford Economic Papers*, 54, 334-65.

Young, S., Hood, N. and Peters, E. (1994), 'Multinational Enterprises and Regional Economic Development', *Regional Studies*, 28, 756-77.